4.6 GEOLOGY AND SOILS

This section describes the geologic setting of the Proposed Project, the topography and soils present, and any geologic hazards, such as erosion or seismic activity. The regulatory setting pertaining to geologic resources is summarized. Any impacts to geologic resources that the Proposed Project may cause are identified, and mitigation measures detailed to address these impacts.

Two site-specific studies have been completed to evaluate geology and soils on the project site:

- Foundation Investigation – Sunset Boulevard Bridge, Auburn Rancheria Casino, Placer County, California. 2001. Taber Consultants, Engineers, and Geologists; and
- Geotechnical Roadway Study – Auburn Rancheria Project, Placer County, California. 2002. Taber Consultants, Engineers, and Geologists.

4.6.1 SETTING

ENVIRONMENTAL SETTING

Geology

The proposed project is located between Roseville, Rocklin, and Lincoln in western Placer County, and within the transition zone between the floor of the Sacramento Valley and the foothills of the Sierra Nevada mountain range. The Sacramento Valley is underlain by marine and terrestrial sedimentary rocks (State of California, 1966). The regional geologic structure of the Central Valley is characterized by sedimentary deposits that dip towards the north-south valley axis. Cenozoic Era (up to 65 million years ago) sedimentary rocks, volcanic mudflow deposits and unconsolidated sediments comprise the uppermost 4,000 feet of valley fill (State of California, 1978). The regional landscape of dissected uplands and small, incised stream valleys is primarily a product of Holocene (up to 10,000 years ago) stream erosion modifying the older alluvial and volcanic deposits at the base of the Sierra Nevada.

Geologic formations mapped in the region include recent alluvium (Holocene), older alluvium of the Turlock Lake Formation and Riverbank Formation (Pleistocene) and volcanic deposits (Pliocene and Miocene). The surface and near surface geologic units outcropping in Sunset Industrial Area are listed and briefly described in **Table 4.6-1**. The project site is shown on published geologic maps (CDMG "Geologic Map of the Sacramento Quadrangle," 1981) to be underlain by Quaternary-age alluvial sediments of the Turlock Lake formation, comprised of silt, sand, and gravel (Taber, 2001).

TABLE 4.6-1
SURFACE AND NEAR-SURFACE GEOLOGIC UNITS OF THE SUNSET INDUSTRIAL AREA

Geologic Unit	Symbol	Geologic Age	Characteristic Composition
Recent Alluvium	Qa	Cenozoic – Holocene	Unconsolidated clay, silt, sand and gravel deposited by the existing (active) stream and river systems. The active stream deposits in western Placer County are typically Holocene in age (less than 10,000 years old).
Basin Deposits	Qb	Cenozoic - Holocene	Unconsolidated silt and clay, originally deposited as overbank flood deposits, in topographic lows of the floodplain.
Riverbank Formation	Qr	Cenozoic - Pleistocene	Semi-consolidated, poorly bedded layers of silt, clay, sand, and gravel, with numerous beds of white to gray-white tuff and tuffaceous silts. Originally deposited by rivers between approximately 100,000 and 400,000 years ago.
Modesto-Riverbank Formation	Qmr	Cenozoic – Pleistocene	Semi-consolidated arkosic (high in feldspar) alluvial deposits of sand, silt, clay, and gravel.
Turlock Lake Formation	Qtl	Cenozoic – Plio-Pleistocene	Consolidated, slightly cemented silt, sand and gravel deposits, with generally horizontal bedding and lenticular units (discontinuous lenses). Originally deposited by rivers and streams as alluvial fans more than 600,000 years ago.
Mehrten Formation	Tm	Cenozoic - Miocene - Pliocene	Cemented andesitic volcanic ash and sediments of volcanic mud-flow origin, with small amounts of sandstone, siltstone, conglomerate, and tuff.
Dioritic Rocks	Mzd	Mesozoic	Intrusive igneous dioritic and granitic rocks of the local "Penryn Pluton", on the periphery of the igneous plutons forming the core of the Sierra Nevada.

SOURCE: Placer County, 1997.

Topography

The proposed roadway corridor is undeveloped and consists of flat land with annual grasses. Orchard Creek, its unnamed tributaries, and a wetland preserve are located north of the proposed site. An unnamed tributary to Pleasant Grove Creek passes through the southeast portion of the site. The land surfaces of the "transition zone," also referred to as "dissected uplands" (Olmsted and Davis, 1961), generally slope west towards the middle of the Sacramento Valley and the Sacramento River. This area covers the project site and extends to the western Placer County border. The surface has rolling topography created by long-term stream erosion of the uplifted terraces. Elevation in the vicinity of the project site ranges from 120 to 140 feet above mean sea level. Active streams in the vicinity are westerly flowing and are intermittent with narrow active floodplains that are entrenched 10 to 15 feet below the local drainage divides. The unnamed tributary to Pleasant Grove Creek is southerly flowing from a marshland located to the east of the proposed roadway alignment. The main ridges and knolls in the

vicinity of the project site can be up to 50 feet higher than the stream channels. No unique geologic or topographic features have been identified in the vicinity of or at the project site.

Soils

Near surface soils conditions on the site are described in the *Soil Survey of Placer County, Western Half,* prepared by the United States Department of Agriculture, Soil Conservation Service (1980). The SCS shows that the majority of the site contains Fiddyment-Kaseburg loams. The Fiddyment loam is described as moderately deep over a silica-indurated hardpan formed over bedded siltstone. The clay loam is underlain by the hardpan and siltstone. The permeability is very slow. The Kaseburg loam is described as well drained shallow soil over hardpan. The surface layer typically consists of 14 inches of loam over a shallow silica-indurated hardpan over siltstone, and permeability is moderate. Soil types within the vicinity of the project site are shown in **Figure 4.6-1.**

To further evaluate the specific soils in the area, the following tasks were completed: drilling and sampling (eight exploratory borings); trenching and sampling (twelve exploratory trenches); and laboratory testing of selected soil samples (Espana Geotechnical Consulting, 2000; Taber, 2001). As a result, the soil conditions observed in the borings generally consisted of 6 inches to one foot of top soil that was underlain by 1 to 4 feet of light brown to brown, moist, stiff to hard, silty clay and dense to very dense sandy silt. This layer was generally underlain by cemented sandy silt or clay to the full depth of the borings. Log records in the report provide more specific contents of each boring.

Soil containing clay was observed near the surface (generally at depths of 1 to 4 feet) at most of the boring and trench locations. Silty-clayey sand to clayey silt was also observed in several of the borings and trenches. Based on the presence of clayey soil, the soil was considered to be expansive. As a result Expansive Index tests were run on samples and the expansion potential was determined to be low. (Espana Geotechnical Consulting, 2000; Taber, 2001). Although the expansion potential was not considered to have a significant impact on the proposed project, specific recommendations to address the potential effects of soil with a low to medium expansion potential are addressed in the mitigation section of this chapter. Due to the high degree of clay in the site's soils, the erosion potential of the soil on or near the surface of the subject site is considered to be low to moderate.

Insert Figure 4.6-1 Soil Map

Site Grading

The geotechnical report prepared for this proposed road project (Taber, 2002) (Appendix E) made the following conclusions regarding site grading and excavation:

> "*Project grading is expected to be performed in accordance with CalTrans 'Standard Specifications,' including Section 19. Grading should include stripping and disposal of the surficial vegetation layer (estimated to depth 3-4 inches), and reprocessing of underlying disturbed soils – estimated to an additional depth of 8 inches. Based on the boring data, no difficulties are anticipated in excavating native soils to proposed roadway grades with typical 'heavy duty' construction equipment. Subgrade preparation consistent with CalTrans 'Standard Specifications' requires at least 95% relative compaction (per CTM 216), or equivalent, on materials to 30-inches below finished pavement grade. With the anticipated pavement sections, this is expected to be generally achieved by scarifying the exposed subgrade to depth 6 inches and compacting these materials to 95% relative compaction. New project cut/fill slopes at design slopes of 1.5h:1v are considered appropriate for anticipated slope-heights of 5 feet or less. Bare slopes should be protected from erosion by vegetation or other appropriate means*."

A second geotechnical report (Taber, 2001) analyzed foundation conditions for the proposed bridge, and made the following conclusions:

> "*The site is considered stable with support available for the proposed bridge foundations. Conditions are considered suitable for standard (CalTrans) 16-inch cast-in-drilled-hole (CIDH) piling – consistent with CalTrans Slab Bridge Pile Details (XS 12-55.1) – achieving bearing in side-friction and end bearing within the dense/hard soils unit underlying the surficial topsoil and channel 'muck.' However, since the possibility of free water within drilled excavations cannot be precluded, the use of 24-inch diameter CIDH piles is recommended, thereby allowing for a wet specification option in the event that 16-inch diameter excavations cannot be adequately dried. Casing through the upper 10 feet is expected to provide adequate ground control, and may be required depending on the location/depth of the high-pressure gas main relative to the foundations. Alternatively, driven concrete or steel pipe piles are considered feasible, but would require pre-drilling as a driving aid to within 5-10 feet of specified tip….Scour is not indicated to be a major design consideration for this site, due to the low gradient and flow velocity. The underlying dense/hard soils (below elevation 108 with the main channel) are considered at least moderately resistant to scour and erosion. Along the west approach, the 175-foot section of channel between Sta. 17+25 and Sta. 19+00 will be established over several feet of soft/wet channel 'muck.' This area will require specific consideration with respect to approach fill design and construction, discussed further*."

The geotechnical report for the nearby casino facility (Espana, 2000) noted that if grading commences in the early spring or after a period of heavy rainfall, it is possible that the surface soil may be saturated due to underlying, relatively low permeability soil trapping water near the surface. This may create loading, hauling, and fill placement difficulties. A period of a month or so after the last heavy rain of the season is necessary to allow the surface soil to dry sufficiently so that heavy grading equipment can operate effectively. Also, possible isolated horizons of wet or saturated sandy soil will also be encountered throughout the year, the likelihood of encountering wet sand horizons will increase during or shortly following the wet season (Espana, 2000). Soil containing clay was observed near the surface (generally at depths of 1 to 4 feet) at most of the boring and trench locations. Some silty-clayey sand to clayey silt

soils were also observed in several of the borings and trenches. Based on the presence of clayey soil, the soil was considered to be expansive. As a result, Expansive Index Tests were run on samples and the expansion potential was determined to be low (Espana, 2000). The erosion potential of the soil on or near the surface of the subject site is considered to be low to moderate, due to the high percentage of clay in the soil. During and after construction, erosion control measures will be implemented. Dewatering is not expected to be necessary for general site grading. Perched groundwater may result in some excessively wet soils. It is expected that isolated areas within the site may require stabilization (overexcavation or drying back) in order to place and compact structural fill and obtain stable subgrades within pavement areas.

Seismicity

The project site is not within 10 miles of any active fault (Taber, 2001). Several dormant, potentially active, and active faults occur in the region that could produce seismic activity at the project site: Prairie Creek-Spenceville-Dentman, 11 miles away; Foothills Fault Zone, West Branch, 14 miles away, and East Branch, 19 miles away; Dunnigan Hills Fault, 26 miles away; Melones Fault Zone, 30 miles away; and Coast Range / Sierra Block Boundary, 35 miles away (Placer County, 1997; Taber, 2001). In 1908, an earthquake of at least 4.0 magnitude on the Richter Scale occurred on an unnamed fault in the southwestern portion of Placer County; no significant seismic event has been recorded since that time in the Roseville Area (Placer County, 1997).

The primary hazards associated with an earthquake are ground surface rupture due to faulting and the effects of ground shaking. While surface rupture is normally restricted to areas along the fault, ground shaking may affect areas around the fault for many miles. Groundshaking and related secondary seismic hazards are the principal form of seismic hazard in the SIA and surrounding areas. Secondary geologic hazards related to seismic events include lurch cracking, liquefaction, differential settlement, and slope failure. The California Department of Mines and Geology's Maximum Expectable Earthquake Intensity Map places the SIA project area in Seismic Zone 3 (a lower severity zone), with a probable maximum ground shaking intensity of VI to VII on the Modified Mercalli Scale.

Agricultural Resources

Soils are grouped into two categories of suitability for cultivation and other agricultural uses: land suited for cultivation (Classes I - IV) and land limited in use, generally not suited for cultivation (Classes V - VIII). The majority of soils in the SIA are generally considered marginally suitable to unsuitable for cultivation (Classes VI and VII). Lands with these soil types are primarily used for cattle grazing on dry pasture; however, some dry farming has occurred on these lands as well. The predominant soil in the area, Fiddyment-Kaseberg, is listed as having high shrink-swell characteristics with an underlying cemented hard-pan. Alamo-Fiddyment soil, also located near the site, is characterized as having severe wetness, low strength, and high shrink-swell properties.

Mineral Resources

CDMG classifies the regional significance of mineral resources in accordance with the California Surface Mining and Reclamation Act of 1975 (SMARA). Mineral Resource Zones (MRZ) have been designated to indicate the significance of mineral deposits. The MRZ categories are as follows:

- MRZ-1 Areas where adequate information indicates that no significant mineral deposits are present, or where it is judged that little likelihood exists for their presence.
- MRZ-2 Areas where adequate information indicates that significant mineral deposits are present, or where it is judged that a high likelihood exists for their presence.
- MRZ-3 Areas containing mineral deposits, the significance of which cannot be evaluated from available data.
- MRZ-4 Areas where available information is inadequate for assignment to any other MRZ.

The 1988 CDMG mineral land classification contains information only for the southern boundary of the Sunset Industrial Area. There are no known mineral resources for this region, which includes the cities of Roseville and Rocklin. These areas contain pockets of land designated as MRZ-1, MRZ-3, and/or MRZ-4. According to the Placer County General Plan Background Report (Placer County, 1992), there are no current mineral resource sites present within the immediate vicinity of the SIA. However, there is currently a large facility for mining of aggregate (sand, gravel, decomposed granite) in Rocklin

REGULATORY FRAMEWORK

Placer County Standards and Permits

Placer County has standards and specifications concerning grading, erosion control, inspection, and permitting. Detailed erosion control and drainage measures are required for all improvement plans. The Placer County Department of Public Works requires and reviews improvement plans, grading permits, building permits, and drilling permits.

Placer County General Plan

The Placer County General Plan contains various goals and policies regarding mineral resources and geologic hazards to guide future project development. The Health and Safety Section of the General Plan provides a goal and policies to minimize loss of life, injury, and property damage due to geologic hazards. Polices which accomplish this goal include, but are not limited to: requiring the preparation of a soils engineering and geologic-seismic analysis prior to permitting development in areas prone to seismic or geologic hazards; requiring that new structures in severe groundshaking areas are designed and constructed to minimize risk to occupants; and prohibiting the placement of habitable structures on critically expansive soils. Some of the relevant policies for the project that support the goal are:

Goal 8.A: To minimize the loss of life, injury, and property damage due to seismic and geological hazards.

Policy 8.A.1: The County shall require the preparation of a soils engineering and geologic-seismic analysis prior to permitting development in areas prone to geological or seismic hazards.

Policy 8A.2: The County shall require submission of a preliminary soils report, prepared by a registered civil engineer and based upon adequate test borings, for every major subdivision and for each individual lot where critically expansive soils have been identified or are expected to exist.

Policy 8.A.7: In areas subject to severe groundshaking, the County shall require that new structures intended for human occupancy be designed and constructed to minimize risk to the safety of occupants.

Consistency with the Placer County General Plan

The proposed project is consistent with the policies contained in the Placer County General Plan; the required soils engineering and seismic analysis and preliminary soils report based on test borings have been performed; the results of these tests indicate a suitable geologic setting for construction of the proposed project.

4.6.2 IMPACTS AND MITIGATION MEASURES

SIGNIFICANCE CRITERIA

The following criteria have been used to determine the significance of geology, soils, and seismicity impacts.

An impact would be significant if it:

- Causes exposure of people or structures to major geologic hazards;
- Causes substantial erosion or siltation; or
- Prevents the recovery of significant mineral resources.

Impact

4.6.1 Grading and soil disturbance to prepare the roadway site may cause slope instability or landform impacts. This would be a significant impact.

Grading will be required to prepare the site for the proposed roadway. Development of the site would involve substantial grading, but given the area's flat topography, significant slope instability or landform impacts would not be anticipated with the implementation of appropriate mitigation measures.

Mitigation

4.6.1a The geotechnical reports make several recommendations to address soil disturbance and grading. They include:

- **All cut/fill slopes should be graded no steeper than 1.5:1 (horizontal to vertical);**
- **Track-walking is not an acceptable method of slope construction or compaction;**
- **Slopes should be overbuilt and cut back to finish grade;**
- **Grading preparation should include removal of all dense vegetation, debris, existing fill materials, and any saturated (yielding or pumping) soils prior to site work operations; and**
- **Strippings are not to be used within structural or pavement fills; strippings could be stockpiled and used as topsoil along the sides of the road.**

These measures shall be implemented as part of the proposed project.

4.6.1b All proposed grading, drainage improvements, and vegetation removal shall be shown on the Improvement Plans and all work shall conform to provisions of the County Grading Ordinance (Ref. Article 15.48, formerly Chapter 29, Placer County Code) that are in effect at the time of submittal.

No grading, clearing, or tree disturbance shall occur until the Improvement Plans are approved and all temporary construction fencing has been installed and inspected. All cut/fill slopes shall be at 1.5:1 (horizontal:vertical) unless a soils report supports a steeper slope and DPW concurs with said recommendation.

The applicant shall revegetate all disturbed areas. Revegetation undertaken from April 1 to October 1 shall include regular watering to ensure adequate growth. A winterization plan shall be provided with project Improvement Plans. It is the applicant's responsibility to assure proper installation and maintenance of erosion control/winterization during project construction. Where soil stockpiling or borrow areas are to remain for more than one construction season, proper erosion control measures shall be applied as specified in the Improvement Plans/Grading Plans. The applicant shall provide for erosion control where roadside drainage is off of the pavement.

The applicant shall submit to the DPW a letter of credit or cash deposit in the amount of 110% of an approved engineer's estimate for winterization and permanent erosion control work to guarantee protection against erosion and improper grading practices. Upon acceptance of improvements, and satisfactory completion of a one-year maintenance period, unused portions of said deposit shall be refunded to the project applicant or authorized agent.

If, at any time during construction, a field review by County personnel indicates a significant deviation from the proposed grading shown on the Improvement Plans, specifically with regard to slope heights, slope ratios, erosion control, winterization, tree disturbance, and/or pad elevations and configurations, the plans shall be reviewed for a determination of substantial conformance to the project approvals prior to any further work proceeding.

4.6.1c No **grading activities of any kind may take place within the 100-year flood plain of the stream nor within the watershed of the vernal pool(s), unless approved as a part of this project.**

Significance after Mitigation

Less than significant.

Impact

4.6.2 The presence of soft or clayey soils may present design constraints for foundations and other site improvements. This is a significant impact.

Most of the borings and trench locations indicated that the soils on site contained silty-clayey soils. Such soils are considered expansive and present particular design constraints. Expansive Index tests were run on samples of the soil to determine expansion potential. Although expansion potential of the site's clayey soil was considered low, recommendations for foundation design are addressed following. The presence of soft / wet soils was also reported, and recommendations were also made for these conditions.

Mitigation

4.6.2a The geotechnical report recommends the following measures:

- "***New embankment placed below 30-inches of finished grade should be placed to at least 90% relative compaction. Comparison of laboratory tests with in-lace dry densities suggests an overall shrinkage from cut to fill in the range of 4-6%. Some additional loss (1-2%) is estimated due to transportation and other construction handling. Actual amount of shrinkage will depend on the degree of compaction effort achieved in construction; compaction greater than 90% would result in somewhat higher overall earthwork shrinkage***;"

- ***"All materials, grading, original ground preparation and compaction for the approach sections should conform to CalTrans "Standard Specification," except as specifically modified below. This includes a minimum relative compaction of 95% (per CTM 216) on all materials within the pavement structural section and all fill within 150-feet of bridge abutments. Pavement design by the CalTrans method also presumes 95% relative compaction on all materials within 30 inches of finished grade***;"

- "***The west approach crosses soft/wet soils extending to depth 2-3 feet below ground surface. It is recommended that these soils be removed to expose a firm surface of underlying dense soil. This surface should be reviewed by a representative of this office to verify uniformity of support prior to receiving fill. Surface water control for the earthwork is considered available by diking, diversion and pumping, as necessary. With this level of preparation, only nominal settlement of the fill and no waiting period for foundation construction is anticipated***;"

- "***If areas of deeper soft soil are encountered along the west approach, or if the saturated fill foundation is difficult to "work" (e.g., soil 'pumping' with repeated equipment passes), then placement of 1-foot gravel (crushed rock) base with an underlying layer of filter fabric could be utilized to establish a firm working base. A non-woven geofabric (for materials separation and drainage) and/or a layer of biaxial geogrid (for structural reinforcement) could be considered at subgrade level;***"

- "***Along the east approach, new fill is expected to be founded within dense native soil present at shallow depth (within 1-2 foot of ground surface). Fill foundation***

preparation in this area should include removal of the surficial soft/loose soil and scarification/compaction of the exposed surface to at least 90% relative compaction (to 95% within 30 inches of finished grade);"

- **"*Structure backfill is required behind bridge abutments to the minimum dimensions as shown on CalTrans 'Standard Plans.' The acceptability of local borrow for use as structure backfill should be verified by laboratory testing and field observation of the borrow exposures*."**

All construction shall comply with the Uniform Building Code, Placer County road standards, and other applicable building codes.

These measures shall be implemented as part of the proposed project.

Significance after Mitigation

Less than significant**.**

Impact

4.6.3 If improperly designed or constructed, seismic activity could cause failure of the bridge structure. This is a significant impact.

Although the project site is not within 10 miles of any active fault, several dormant, potentially active, and active faults occur in the region that could produce seismic activity at the project site. The primary hazards associated with an earthquake are ground surface rupture due to faulting and the effects of ground shaking. While surface rupture is normally restricted to areas along the fault, ground shaking may affect areas around the fault for many miles. Groundshaking and related secondary seismic hazards are the principal form of seismic hazard in the SIA and surrounding areas. Secondary geologic hazards related to seismic events include lurch cracking, liquefaction, differential settlement, and slope failure.

Mitigation

4.6.3a The geotechnical report by Taber (2001) analyzed seismic risks in the project area, particularly for bridge design. The report concluded:

"*The site is not within 10 miles of an active fault and no increase in spectral acceleration is indicated per SDC procedures. A design ARS curve per SDC Figure B.4, with M6.5+/-0.25 earthquake, Type-C soil profile and PBA of 0.2g, is recommended for this site. Should there be important structural and/or economic considerations associated with more closely defining these values or other site seismicity characteristics, further study would be required. The potential for soil liquefaction to affect the bridge foundations is considered low due to the overall dense/hard consistency of the underlying soils. The few feet of very soft channel "muck" is susceptible to densification, settlement and/or lateral spreading under conditions of strong ground shaking, but with bridge foundations and approach fill as*

***discussed below, no adverse effects on the structure owing to secondary seismic effects are expected."* (page 5)**

All construction shall comply with the Uniform Building Code, Placer County road standards, and other applicable building codes.

These measures shall be implemented as part of the proposed project.

Significance after Mitigation

Less than significant**.**